U.S. Department of Energy
Office of Civilian Radioactive Waste Management

YUCCA MOUNTAIN PROJECT

Postclosure Thermal Conditions at Yucca Mountain: How Hot Should It Get?

Presented to:
Nuclear Waste Technical Review Board

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Outline

- Issues Related to Postclosure Thermal Conditions
- Work Completed to Address Issues Related to Postclosure Thermal Conditions
- Analyses of Postclosure Thermal Conditions
- Testing to Address Postclosure Thermal Conditions

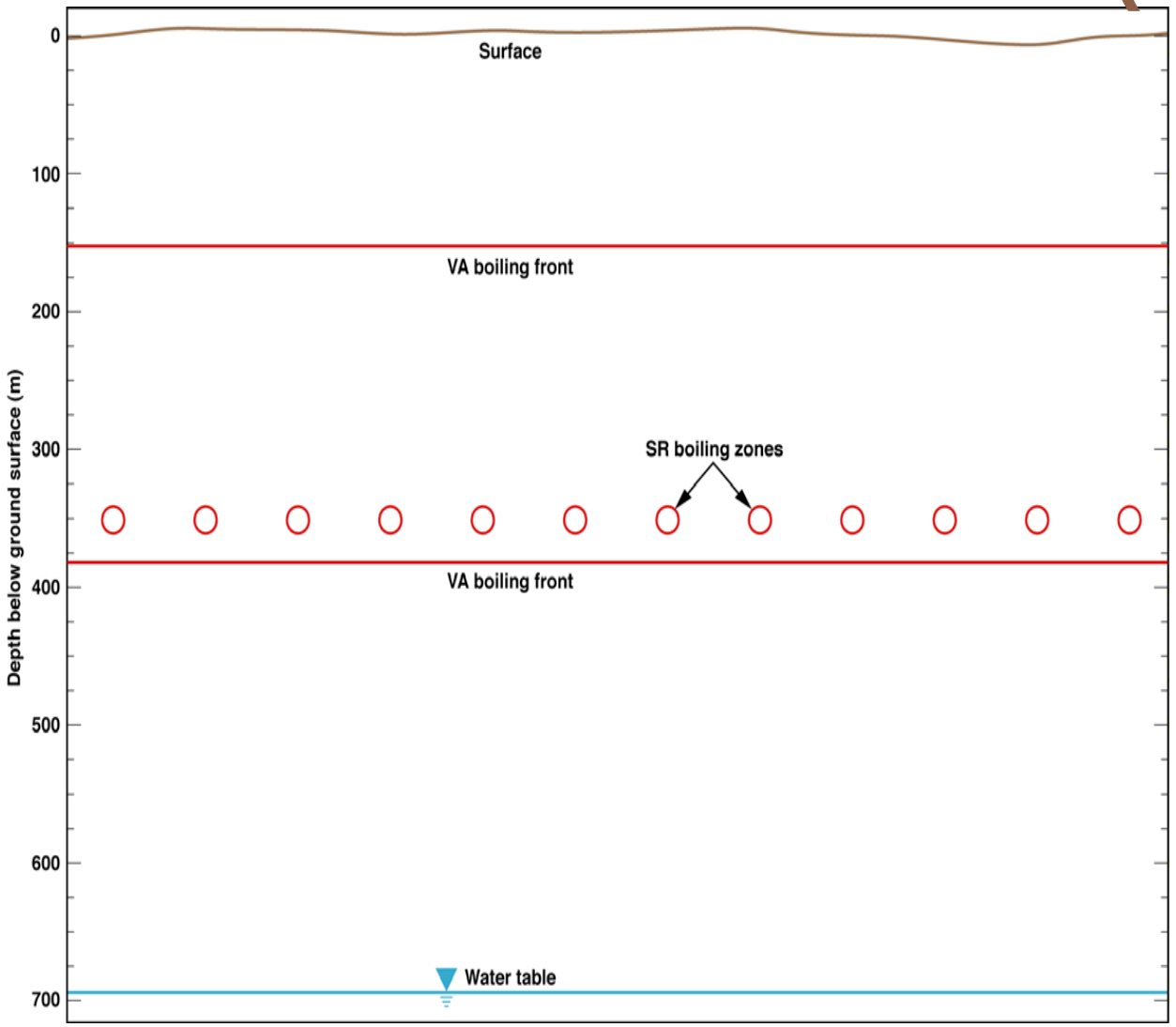
Issues Related to Postclosure Thermal Conditions

- **DOE's interpretation of the Board's main concerns with respect to postclosure thermal conditions for the Viability Assessment (VA) design (1998)**
  - **The potential for corrosion of the corrosion-resistant waste package material would be significantly reduced if peak waste package surface temperature were reduced**
  - **There would also be significant reduction of coupled thermal-hydrologic and thermal-geochemical processes at lower temperatures**

Work Completed to Address Issues Related to Postclosure Thermal Conditions

- **Evaluated alternative designs (License Application Design Selection Report - 1999)**
- **Evolved to the Site Recommendation (SR) design with lower temperature postclosure thermal conditions (2000)**
- **Evaluated higher (SR) and lower postclosure thermal conditions - Supplemental Science and Performance Analyses (SSPA- 2001)**
- **Enhanced the experimental program to address corrosion processes and waste package environment**
- **Completed the Waste Package Materials Performance Peer Review**

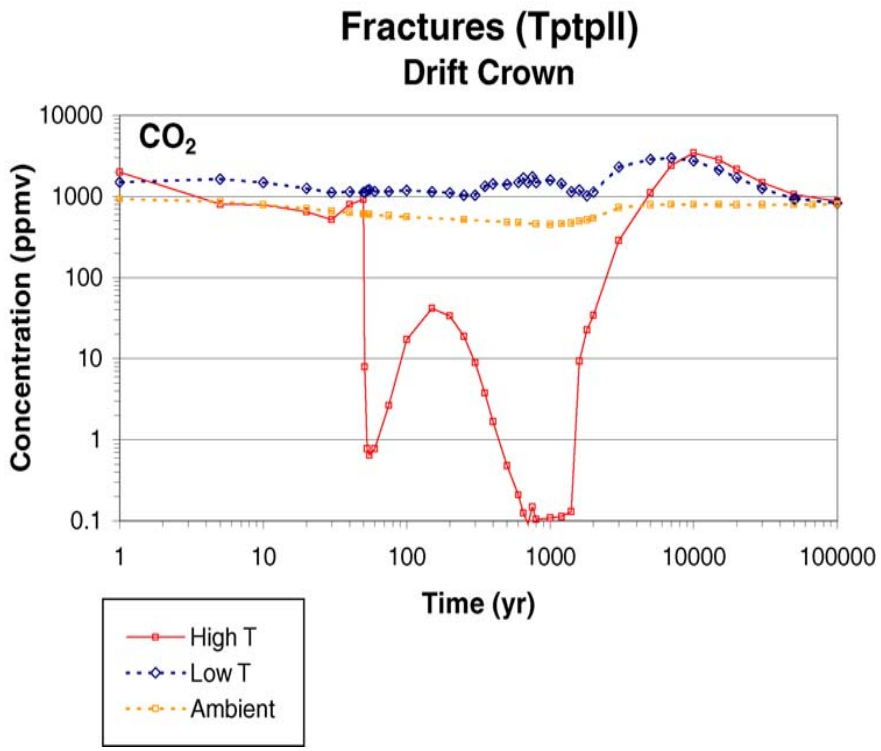
Evolution of Thermal Conditions (VA - SR)

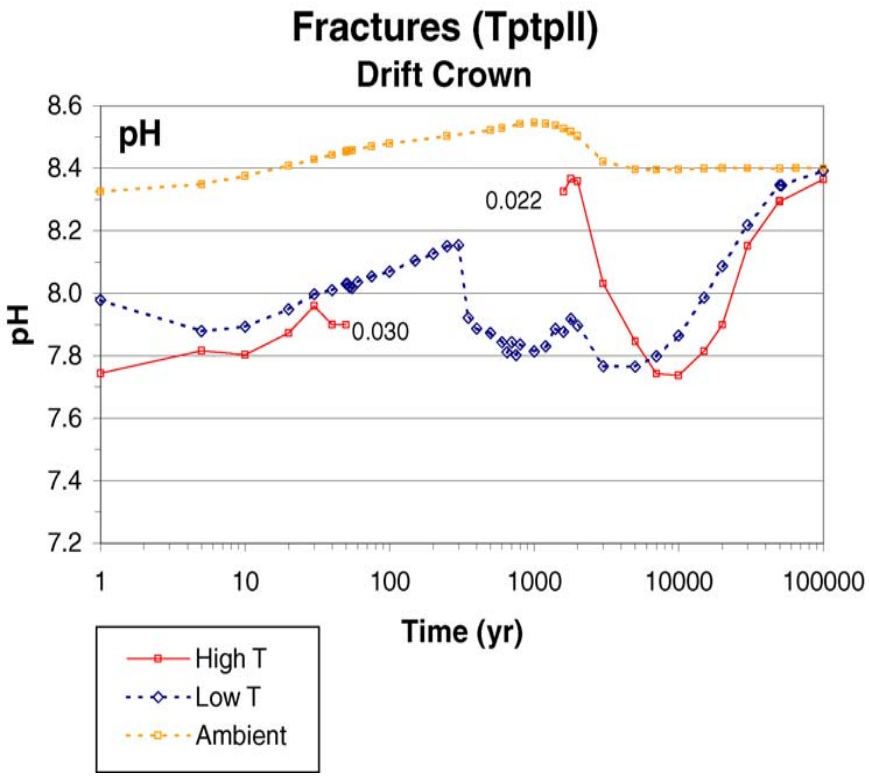


Analyses of Postclosure Thermal Conditions

- **DOE analyzed higher (SR) and lower postclosure thermal conditions (SSPA)**
  - **Some differences in performance were observed at the subsystem level for some models**
  - **System level performance was essentially the same for both higher and lower postclosure thermal conditions**

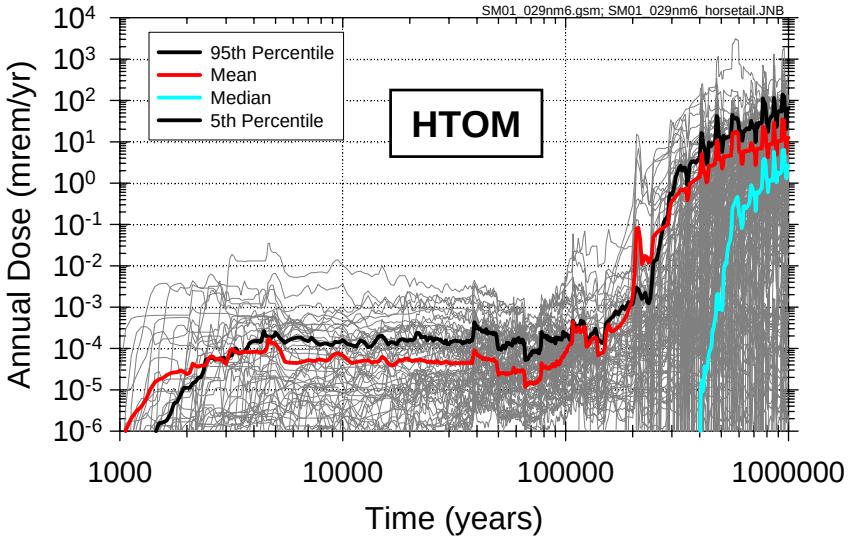
Example Subsystem Level Analyses

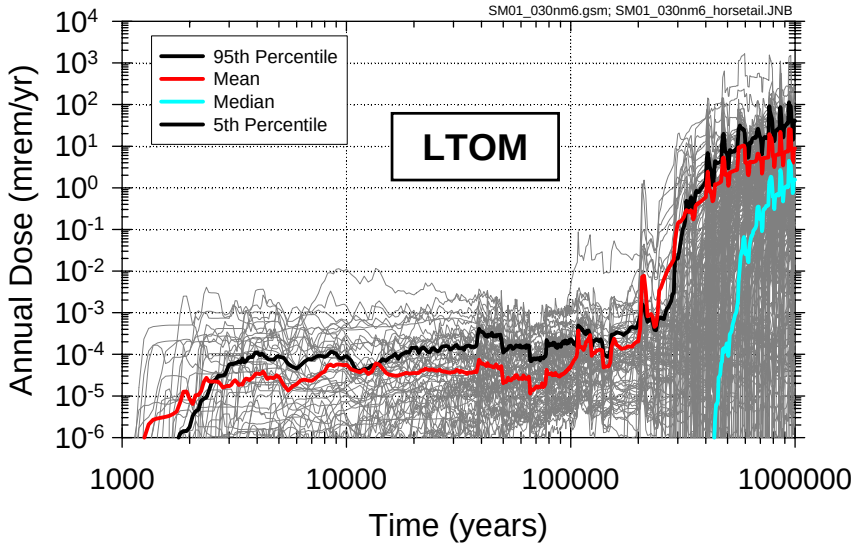




Chemistry for higher and lower temperatures at the drift scale: carbon dioxide (left panel) and pH (right panel)

Total Dose Uncertainty





- **TSPA models apply to both LTOM and HTOM**
- **The TSPA uncertainty ranges for HTOM and LTOM are similar**
- **Process level models evaluate subsystem uncertainties, which in some cases, are propagated in TSPA abstractions**

LTOM - Lower Temperature Operating Mode
HTOM - Higher Temperature Operating Mode

Overall Evaluation (02/02)

- **For preclosure**
  - **Dose estimates are below the regulatory limit for both cases**
  - **Preclosure safety hazards and costs may be higher for a lower postclosure thermal condition (increased excavation, longer timeframes)**
- **For postclosure**
  - **Confidence in subsystem effects on total dose is higher for lower postclosure thermal condition because larger thermal effects contribute to uncertainty**
  - **For postclosure system level performance, both cases result in doses that are well below the regulatory limit**
- **The results of this study indicate the a Yucca Mountain repository will work for both cases**
  - **Additional work will be completed before a decision will be made on postclosure thermal conditions**

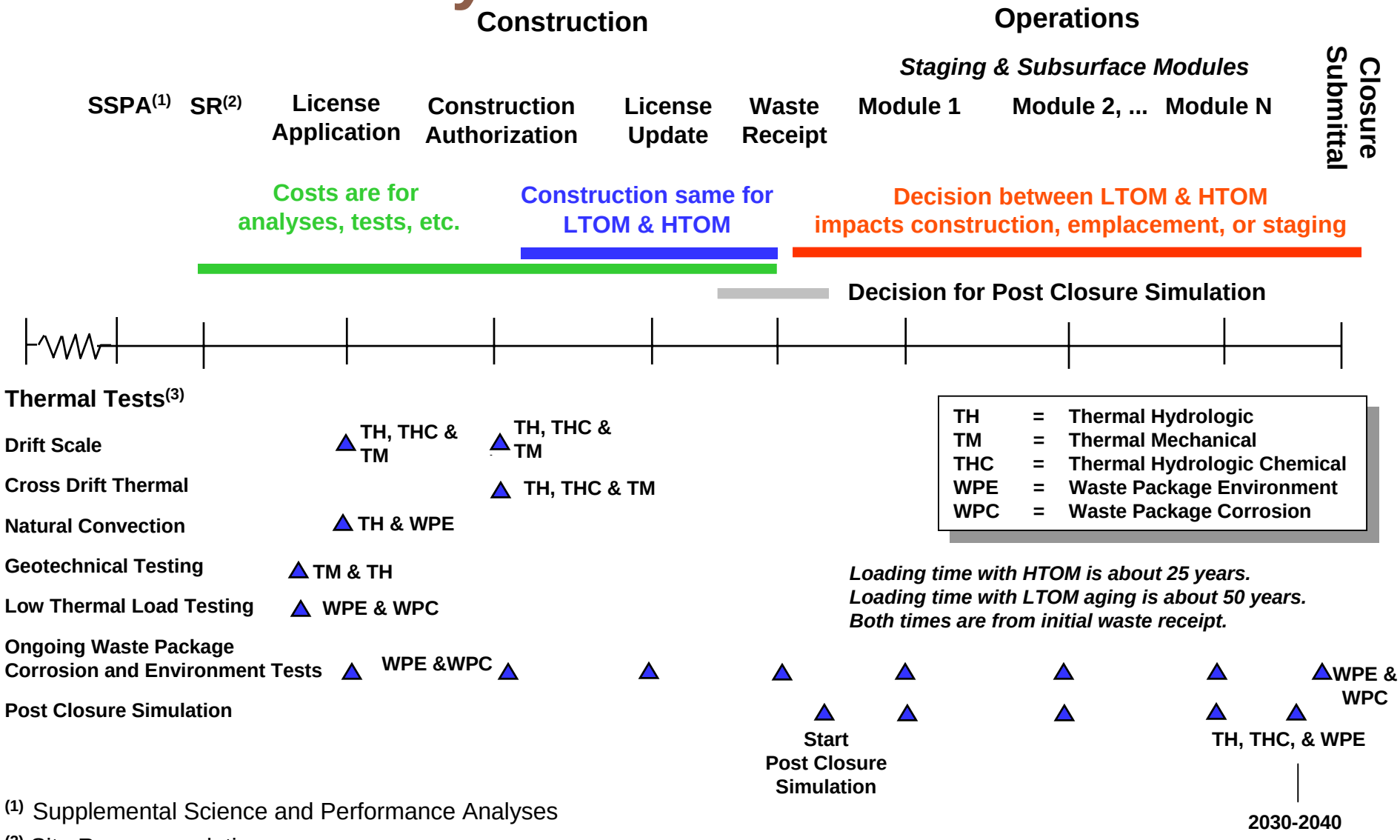
Plans to Address Postclosure Thermal Conditions

- **TSPA for License Application (LA) will analyze a design that leads to postclosure thermal conditions similar to the SR Design**
- **This approach does not preclude closing in a cooler mode. Lower postclosure thermal conditions can be achieved by**
  - **Adjusting the amount of aged fuel, the aging duration, and the ventilation rate and/or duration**
  - **Derating waste packages**
  - **Varying waste package spacing**
- **Subsequent decisions will be informed by results of ongoing tests, analyses, and modeling**

Testing to Address Postclosure Thermal Conditions

- **The following tests will provide a stronger technical basis for decisions on thermal operating conditions**
  - **Drift-Scale Thermal Test**
  - **Cross-Drift Thermal Test**
  - **Natural Convection Test**
  - **Geotechnical Tests**
  - **Low Thermal Load Testing**
  - **Waste Package Corrosion and Environmental Tests**
  - **Postclosure Simulation Test**

Availability of Thermal Test Results



(1) Supplemental Science and Performance Analyses

(2) Site Recommendation

(3) Times shown are for completion of tests, not completion of analyses

Recent Test Results

- **Recent test results suggest that**
  - **Large portions of the repository have benign in-drift environments for corrosion for extended periods of time**
  - **Portions of the repository will pass through aggressive in-drift environments for shorter periods of time**
  - **Work is continuing to improve our understanding of how much of the repository will see aggressive conditions for and for how long**
  - **Mark Peters and Gerald Gordon are discussing some specific test results today**